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SHOULD ARITHMETIC BE TAUGHT TO ALL PUPILS
IN THE HIGH SCHOOL? WHEN? HOW MUCH
TIME SHOULD BE GIVEN TO IT?

BY FRANK H. SCOBEE.

There is in my opinion no doubt whatever but that some arithmetic should be taught to all pupils in the high school.

I do not know that there is any well-defined opposition to such opinion, but I do know of some who are not in favor of a review which covers the ground of arithmetic in the same way as it was done in the grammar school and with such objection to arithmetic in the high school I am entirely in sympathy.

In nearly all of our New Jersey school systems arithmetic is taught in the eight grades of the elementary school and judging from the students who come to our normal school about 25 per cent. of these have reviewed the arithmetic of the seventh and eighth grades sometime during the four years of the high-school course.

It would seem as though eight years is long enough to spend upon this beginning branch of mathematics without carrying the subject into the high school. It would be were it not that parts of the subject are beyond the mental grasp or maturity of mind of the pupil at the time they are presented. I do not think that little children of the first and second grades, as a rule, can comprehend the abstractions of number or pure number relations. These children would make more rapid progress if the study of the facts and processes of number were begun two years later. The next four years should be devoted to perfecting them in accuracy and a reasonable degree of rapidity in the fundamental processes, fractions, decimals and the elements of percentage with just enough rationalization of these processes and application to their surroundings or environment to lead them to understand and appreciate the purpose of arithmetic.

These are the years when children are most interested in mechanical processes. It is, when all things are considered, the

period during which they make the most rapid progress in calculation with reasonably large numbers.

In the seventh and eighth grades, that is those which immediately precede the high school, there should be an enrichment of the course in the way of applications. These I briefly mention under the heads of mensuration of some of the planes and solids, taking those which can be made concrete through the use of simple apparatus; applications of percentage to such business as we suppose a pupil of these grades can understand, such as profit or loss, a little of commission; taxes in connection with town expenses and such other very simple applications of arithmetic to social and industrial life as will appeal to their experience, emphasizing any application of community interest. Topics that pertain to investments of money, stocks and bonds, bank discount and exchange are often meaningless particularly when these exercises have no better bases than those afforded by the definitions and meager information of the textbook. But even where these topics are well taught I often hear my pupils say: "I never understood stocks and bonds or bank discount from my study of them in the grammar school."

The place for these topics of arithmetic is in the high school when the pupils can bring to them more maturity of mind and when they may often be correlated with topics of like nature and which belong in the high school. For illustration: If pupils take up a commercial course in the high school the study of discount should be in connection with commercial paper; stocks and bonds with the study of business associations or corporations. Just as the mathematics of the school shop, of domestic science, of agriculture are best studied where these activities are carried on. Even if these subjects are not included in the high school it is better to wait until such a time as the student has sufficient maturity of mind to understand something about the conditions upon which they are based and this is not before the high-school age. Probably the later they can be deferred in the high school the better.

Such topics as Euclid's method of highest common divisor and least common multiple of decimal numbers should be eliminated from arithmetic. Many teachers prefer to retain these on account of their supposed discipline. Whatever we may think

about this they should be taught in connection with the literal processes in algebra. If nothing more practical than a good test of the power to multiply and divide correctly they do afford that.

Cube and square roots of decimal numbers are more easily rationalized if associated with like algebraic processes. I do not think these topics have a place below the high school.

The progressions were always a part of the older arithmetic but have long been relegated to their place in algebra.

Many applications in percentage may be made a part of algebra, where the use of X for the unknown quantity facilitates or abbreviates the process. Some of you can go back with me to Olney's complete algebra, which devoted a considerable portion of the book to the topics of percentage and its applications. Some of these are obsolete now, but the plan of making algebra an instrument for generalizing the processes of arithmetic is a good one.

When a teacher in the high school some years ago, it was the custom to set aside a period of the last semester for a review of arithmetic. While this is the plan of which I do not approve I refer to it merely for the purpose of remarking that the students who were preparing for college brought to it a maturity of mind and a consequent interest because of this better understanding.

Many of our high-school students enter our normal schools, where the work should be that of adapting the subject matter of arithmetic to the grades of the elementary school and studying as far as possible the method of teaching it. It is a great handicap and one of general complaint in normal schools that our pupils do not understand the subject matter of arithmetic. Time must be taken to teach the arithmetic that should have been acquired in high school.

While I believe that all pupils in the high school should be taught some arithmetic it is better if possible that its applications be made to new fields. Correlations should be made as indicated with the higher branches of mathematics, with commercial and other pre-vocational subjects, with the physical and economic sciences.

As the use of arithmetic is to make concrete or determine the

quantitative side of these subjects the time for teaching it must always be wherever the opportunity arises and in close connection with the subject itself. The amount of time devoted to it can only be determined by the nature of the subject with which it is associated and the need of the pupil but the drill in the use of figures should be just as thorough and the pupil be made as efficient as though a term were set apart for the study of arithmetic.

STATE NORMAL SCHOOL,
TRENTON, N. J.

BY AMY L. CLAPP.

Evidently, we agree as to the child's great and lamentable ignorance of arithmetic—the only question to be considered concerns the remedy to be applied. The most obvious one is “to give all pupils arithmetic during their first term in the high school.” This seems hardly efficient, for, besides discouraging the pupil by repeating exactly the same subject that she has had, and often disliked, in the elementary school, we should also have to use the same methods that have been used before. Can we expect that our training, unlike that of the faithful elementary teacher, will endure permanently?

It seems to me that it would be more strategic to approach the subject from a different angle, that of algebra, and, besides gaining the increased interest due to a new subject to shape the course that it will definitely help the situation in arithmetic.

The pupil's weakness in arithmetic can be classed under two heads:

1. Lack of general mathematical common sense.
2. Inability to calculate quickly and accurately.

This first includes many things—among them is ability to read the problem and to reason. I need not try to prove to this group that algebra will help here in short word problems, that will teach the pupil to think more clearly. Then the pupil's ignorance of “short cuts” and slowness to comprehend and use them when taught can be helped if she is shown how they depend upon algebraic principles—*e. g.*, $678 \times 245 = 678 \times 145$; or 51×49 . Ease in solution of percentage problems can be increased if the equation is used. Lastly, the pupil's knowledge or rather lack of knowledge of fractions can be helped if we follow the ex-

ample of those teachers who use algebra explicitly to cast light on arithmetic. In teaching algebraic fractions, they refer to the, theoretically, familiar arithmetical fractions, and lose no opportunity to review fractions by giving both numerical substitutions involving fractions and also equations to be checked that have fractional roots.

This last touches on what I think is the most serious phase of the whole situation—the inability to calculate quickly and accurately, and, what is far worse, the habit of the pupil to pride herself on the fact that she cannot, for instance, add. She seems to regard the elementary operations as childish and quite beneath the notice of a person of her advanced age. In our school, we are trying to correct this by giving to all our commercial girls a daily drill in accuracy. At present, half of these are using the Curtis Practise Tests, and the results are so good with this half that hereafter we expect to do all our drilling by means of these. This regular drill accomplishes two things, first, it increases their accuracy and speed, second, and more important, it is subtly changing their attitude towards such work. My own little beginners in algebra were really mortified the other day when they made careless mistakes in adding $+27$ and -19 —a welcome change from the high-school student's usual attitude! Next term, we expect to give to all our pupils entering from the grammar school, regardless of their course, this same drill in the Curtis Practise Tests.

So much for the question of arithmetic during the first year of the high school—the decision as to whether a girl is later to take it depends, I think, largely on what she intends to do after graduation. Some definitely need it for their future training—*e. g.*, the commercial girls must take commercial arithmetic in their junior year in connection with their bookkeeping, and those girls preparing to go to the normal school must have a half year of arithmetic during their senior. But generally, it seems as if, with this first year drill, a girl could, more profitably, spend her time elsewhere in mathematics than in arithmetic.

SOUTH PHILADELPHIA HIGH SCHOOL FOR GIRLS,
PHILADELPHIA, PA.

BY RUTH MUNHALL.

To the first of these queries I would answer yes—decidedly yes. Arithmetic should be taught in the high school, and if the courses were not so crowded I should say to all pupils; for I have found almost without exception that the chief difficulty that besets the girl in algebra is an inability to perform simple arithmetical operations correctly; and that most of the failures are due to inaccuracy—and a good stiff course in arithmetic would go far to remedy this one besetting sin common to nearly all pupils.

But of course I fully realize that the time given to one subject is limited and that my desire to give all girls a good stiff course must be modified so I will take the subject up in four divisions; dealing separately with the four courses that we offer in the Philadelphia high schools.

First. The College Preparatory Course.—Here, we all realize, the work is very heavy, but it seems to me that we could slip in a little practice in old-fashioned mental arithmetic, which would be of great benefit to them all. It would help them to think more quickly and more accurately. A five-minute drill each time the class meets would be possible; in fact I am trying it in my senior class and the girls seem to enjoy it; as yet it is too early for me to say how profitable it will prove to them, but I am pretty sure that it will be worth the effort. Whether the senior year is the best place or not for this work I cannot say, but under present conditions it seems the logical place to put it.

Second. The General or Normal School Preparatory Course.—With us these girls do have a half year of arithmetic, but it seems to me that a longer course would be advisable for these girls are to be the future teachers of the children whom we will eventually get and if we could impress upon these potential teachers the importance of arithmetic we would in a roundabout way be preparing better material for the high school, as far as mathematics is concerned. This work ought to be in the senior year and ought to continue for a whole year. But just here we meet with the fact that an algebra review is given to the general girls for the first half of the senior year. And this is necessary, but would it not be possible to give these girls five hours of mathematics instead of three and thus give a longer time to the

arithmetic, either alternate the subjects or put the algebra into the first third and allow the arithmetic to take the last two thirds of the year.

Thirdly. The Domestic Science or Home Economics Course.—These girls should have a course in arithmetic during the first or second year—preferably the second. This course should comprise simple computations such as bills, budgets, household accounts of all sorts, measurements, estimation of the amount of material needed—given the dimensions, drill work for accuracy, some formula work. A very good thing would be to have a course in the senior year open to these girls. In this course more difficult work could be taken up and they, having more mature minds, would be able to better realize how much they need the work.

And last but by no means the least important comes the commercial course and there is one thing about which I have strong convictions, and that is that it should not be given in the first year. I have taught it to both freshmen and sophomore classes and I can truly say that the freshman class is not able to take in what the second year pupils can. I want a year of preparatory mathematics—algebra—then a year of good solid commercial arithmetic with plenty of drill work to try and develop accuracy. Then if the course can permit of it, it would be well to give these commercial girls a chance to have a term of arithmetic in their senior year. This course to treat of some of the harder commercial transactions. If this course is required put off teaching building association, stocks and bonds, and kindred subjects until the senior year. I have never tried this but I think it would work out well for these subjects seem hard for the majority of the girls in the first years, since they have no knowledge of business and lack this foundation, which they acquire as they take up their commercial subjects.

In looking back it seems to me that I have asked for a good deal but I am sure not for more than is needed. And I can reiterate my first statement: Yes—decidedly yes. Arithmetic ought to be taught to all pupils in the high school.

HIGH SCHOOL,
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